

observers have given to the so-called "canals" a hardness and an artificiality which they do not possess, with the result that discredit has been brought upon the whole canal system. No doubt the time has come when a distinction must be made between what is real on *Mars* and what is subjective or illusory, but of the substantial accuracy and truthfulness (as a basis on which to work) of the planet's configuration as charted by the great Italian in 1877 and subsequent years, there is, in my mind, no doubt.

(3) Contrast, as has been so ably pointed out by M. E. M. Antoniadi, is doubtless accountable for very many of the extraordinary appearances observed on the planet. Not a few of the canals are now seen to be the intensified edges of faint tones in accordance with the late Mr. Green's suggestion, while M. Antoniadi's explanation of the phenomena of gemination as due to the same effect of contrast appears both simple and satisfactory.

Observations of White Spots on Saturn in 1903.
By A. Stanley Williams.

The visibility of a bright spot on *Saturn* was announced by Professor E. E. Barnard on June 24 of the present year. Unfortunately I had just left England for Ireland, so that, although Professor Kreutz kindly sent me a postcard announcing the discovery, it was only on my return home towards the end of July that I heard of the existence of the spot, and was able to make any observations of the planet. At that time the probable position of the spot detected by Barnard was quite unknown, so that I confined my attention simply to observing the transits of any spots that might happen to be visible, purposely avoiding any attempt at comparing the observations, or to identify them with the spot referred to, in order that the observations might not be biassed thereby.

The observations recorded below all relate to white spots * situated in a bright zone lying to the north of a broad dark band on the north side of the bright equatorial zone. The former bright zone is hereafter termed the N. temperate zone. The broad dark band between it and the equatorial zone has been called the N. equatorial belt. It is actually coarsely double, consisting of two dark bands separated by an ill-defined lighter interval, not so bright or definite as either the equatorial zone or the N. temperate zone. The telescope used was a 6½-inch reflector, a power of 225 being always employed. At first great

* I have called the spots *white* spots for distinction, but they have usually appeared to me to be distinctly yellowish.

difficulty was experienced in observing the transits of the spots with any satisfaction owing to the observer being out of practice, and consequently the earlier observations are usually less satisfactory than the later ones. The weather, moreover, proved most unfavourable, and this, combined with the low altitude of the planet, formed a serious obstacle to obtaining satisfactory results. The observations that I have been able to obtain are therefore comparatively few in number, and not so accurate as I could have wished. For this reason I have not attempted to make any discussion of the results, or any identification of the spots observed, of which, however, it is evident that there must be several. Since, however, these observations may be of value in conjunction with those of other observers for determining the rotation period of the surface material in this latitude of *Saturn*, the full details of them are given below :—

1903 July 24, 11^h 34^m (G.M.T.) White spot transited. Weight (on a scale ranging from 1, bad, to 5, good)=1. Time very uncertain owing to definition being very unsteady, though the spot itself was certain. When first seen, $\frac{1}{4}$ ^h earlier, it was some distance E. of the central meridian of the disc. Once the spot seemed to be double east and west.

July 31, 10^h 50^m. A plain white spot visible about $\frac{1}{2}$ ^h before transit. The following *estimated transits** were observed :—13^h 33^m—12^m=13^h 21^m; 13^h 41^m—20^m=13^h 21^m. Both were rough estimates owing to the image being dim from cloud.

August 3, 11^h 18^m. A plain, round, well-defined spot transited. W.=2. The following estimated transits were also observed :—11^h 07^m+23^m=11^h 30^m (good); 11^h 13^m+07^m=11^h 20^m (good); 11^h 29^m—12^m=11^h 17^m (fair); 11^h 37^m—22^m=11^h 15^m (good).

August 13, 10^h 24^m. Small, rather well-defined white spot estimated 10^m past transit, which therefore occurred at 10^h 14^m.

August 22, 11^h 03^m. Small, rather faint, inconspicuous spot transited. W.=1. It seemed, however, to be pretty well defined. The following estimated transits were also made :—10^h 55^m+8^m=11^h 03^m; 11^h 13^m—7^m=11^h 05^m; 11^h 16^m—12^m=11^h 04^m; 11^h 18^m—15^m=11^h 03^m (widely past transit).

September 1, 9^h 20^m. Very bright and plain spot transited. W.=1, very rough owing to poor seeing. The following estimated transits were also observed :—9^h 13^m+12^m=9^h 25^m; 9^h 29^m—7^m=9^h 22^m (distinctly past transit, but only slightly so); 9^h 34^m—10^m=9^h 24^m. Note added September 2 : “For a long distance preceding this spot the N. temp. zone was very bright and luminous looking.”

September 3, 8^h 47^m. A remarkably plain, bright, and definite spot transited. Definition good, but cloud came up, so that the above time is only very approximate.

September 5, 9^h 43^m. A rather well-defined spot estimated

* See *Monthly Notices*, vol. liv. p. 298.

20^m past * transit, which therefore occurred at 9^h 23^m. Following this spot the N. equat. belt seemed broader than usual, so as to encroach on the N. temp. zone, which latter was narrow and faint, with one or two small faint spots following the central meridian. On the same date the following estimated transits were made of a small and difficult spot :—10^h 26^m + 30^m = 10^h 56^m; 10^h 46^m + 25^m = 11^h 12^m (very rough); 10^h 52^m + 17^m = 11^h 09^m (very rough).

September 7. The following estimated transits of a rather bright and not difficult spot were observed :—8^h 46^m—15^m = 8^h 31^m (fair obs.); 8^h 54^m—25^m = 8^h 29^m (rough estimate owing to frequent clouds).

September 9, 9^h 08^m. An apparently pretty plain spot transited, but seeing very indifferent. W. = 1. Same date, 10^h 41^m. A well-defined and fairly bright spot transited. W. = 2. The following estimated transits were also observed :—10^h 32^m + 10^m = 10^h 42^m (good); 10^h 52^m, the spot seemed distinctly past transit, but seeing very confused. The spot appeared to be rather a bright one for a *Saturn* spot.

September 13, 8^h 50^m. A bright, plain white spot transited. W. = 2. The following estimated transits were also observed :—8^h 34^m + 13^m = 8^h 47^m (good); 9^h 04^m—20^m = 8^h 44^m (good). Same date, 10^h 24^m; a white spot transited. W. = 2. Spot difficult to observe owing to indifferent seeing. It was strongly suspected to be double east and west. The following estimated transits were also observed :—10^h 08^m + 16^m = 10^h 24^m (poor obs.); 10^h 11^m + 12^m = 10^h 23^m (fair); 10^h 17^m + 5^m = 10^h 22^m (fair); 10^h 33^m—8^m = 10^h 25^m (poor estimate).†

September 14, 9^h 59^m. White spot estimated 12^m past transit, which therefore occurred at 9^h 47^m. Seeing very poor and spot difficult to observe.

September 17, 10^h 07^m. A rather small but bright, well-defined, and nearly round spot transited. W. = 2. The following estimated transits were also made :—9^h 57^m + 10^m = 10^h 07^m (good); 10^h 14^m—8^m = 10^h 06^m (good).

September 22. The following estimated transits were observed of a rather bright and pretty large spot, which was not at all difficult :—9^h 16^m—10^m = 9^h 06^m (good); 9^h 22^m—15^m = 9^h 07^m (indifferent); 9^h 24^m—20^m = 9^h 04^m (fair). At 9^h 36^m another white spot transited. W. = 1. This spot was very small and inconspicuous, and much more difficult than the previous one, though it seemed to be well defined. The following estimated transits were also observed :—9^h 22^m + 10^m = 9^h 32^m (rough); 9^h 24^m + 12^m = 9^h 36^m (fair).

* The observation is actually entered as 20^m before transit, but it is pretty certain that the spot must have been past transit from the note that follows.

† The two observations of September 13 are not quite independent, as the observer had a rough recollection of his observations of September 9, when probably the same spots were observed, assuming a rotation period of about 10^h 38^m.

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September 23, 9^h 21^m. Small, faint, inconspicuous spot transited. $W. = 1$. Some very sharp views of *Saturn* were obtained on this night, but there were no *conspicuous* white spots in sight. The N. temp. zone seemed to be very narrow in this part of the planet.

In the following table I have brought together all the observed transits of spots in the N. temp. zone. The concluded times of transit are what seem to me to be the most probable times according to the foregoing observations. The relative degrees of accuracy are indicated in the third column. With reference to observations of this kind, made under such unfavourable conditions, it should be mentioned that it is very difficult for an observer to avoid being biassed in his subsequent estimates by his first view of a spot. I have tried hard to avoid being thus biassed, but cannot hope to have escaped this influence altogether. The trouble is that in trying to struggle against the influence of such a first impression one is apt to err in the opposite direction.

Concluded Transits of White Spots on Saturn.

Date.	G.M.T. of Transit. h m	Weight.	Notes.
1903 July 24	11 34	1	Perhaps double.
31	13 21	1	Plain spot.
Aug. 3	11 19	4	Plain, round, well defined.
13	10 14	1	Small, rather well defined.
22	11 03.5	2	Faint, inconspicuous.
Sept. 1	9 22	2	Very bright and plain.
3	8 47	1	Remarkably plain and bright.
5	9 23	1	Rather well defined.
5	11 05	1	Small, difficult.
7	8 30	1	Rather bright, not difficult.
9	9 08	1	
9	10 41	3	Rather bright.
13	8 48	3	Plain and bright.
13	10 24	3	Suspected double.
14	9 47	1	
17	10 07	3	Small, bright, nearly round, well defined.
22	9 06	1	Pretty large, rather bright.
22	9 35	2	Very small.
23	9 21	1	Small and faint.

It remains to add a few words on the appearance of the spots. Generally speaking, the N. temperate zone was extremely brilliant, but it was very irregularly bright. In some parts of the

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planet it was exceedingly bright and luminous looking, whilst in other places it was comparatively dull and lustreless. The spots constituted the brightest regions of this irregularly luminous zone. They were frequently indefinite, particularly in an east and west direction, so that it was often difficult to locate their position satisfactorily, or even to fix upon anything sufficiently definite to observe the transit of. They also sometimes gave the impression of being double in an east and west direction, though it was difficult to be sure of this in the unsteady definition almost always prevailing at so low an altitude. The unsteady seeing formed, I think, the chief obstacle to making good observations. Under more favourable conditions I believe the spots would have been plain and easy objects. Too much value should not be placed upon the descriptions of the spots in the notes, as their visibility would no doubt be greatly affected by the unfavourable conditions of the seeing, so that the same spot might be described as being plain and relatively bright on one night, and only as faint and inconspicuous on another night, without any real change in brightness or appearance being necessarily implied thereby, the difference arising merely from the circumstance that on one of the nights the bad seeing did not permit the spot to be seen so clearly as on the other.

In general appearance these N. temperate spots had considerable resemblance to the white spots which I observed about ten years ago in the equatorial zone,* but the latter spots were probably not quite so bright and luminous looking as the former.† During the course of the recent observations I have on several occasions examined the equatorial zone. It appeared remarkably white, whiter than the N. temperate zone, and there were faint but distinct indications of brighter spots in it, though compared with the last-mentioned zone it was very uniform in brightness. Owing to the unfavourable position of *Saturn* no systematic observation of these equatorial spots was attempted. On August 13, however, a faint spot was observed to transit at $10^h 43^m$. Also on August 21 a comparatively bright and conspicuous spot was visible in the equatorial zone. At $10^h 0^m$ it was estimated to be 13^m before transit, but owing to cloud the transit could not be directly observed. The spot, which was well defined, seemed to be divided into two by a narrow, faint, dark belt in the equatorial zone, probably the same belt as that which used to be known as the "equatorial mottled belt."

* See *Monthly Notices*, vol. liv. p. 309, and vol. lv. p. 361.

† During the past two or three months the equatorial spots have certainly been decidedly fainter and more difficult than the N. temp. spots.

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1903 October 13.